Enabling quantum interference between non-degenerated correlated photons using optical single sideband modulator

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Frequency translation of single photons while preserving their quantum characteristics is an important technology for flexible networking of photonic quantum communication systems. Single photon frequency conversion experiments have been demonstrated using the nonlinear optical processes such as parametric conversion [1,2] and cross-phase modulation [3]. Here, we propose and demonstrate a simple scheme to translate the frequency of single photon using an optical single sideband (OSSB) modulator, or a nested Mach-Zehnder intensity modulator based on electro-optic effect [4]. Using the OSSB modulator, we successfully erased the frequency distinguishability between non-degenerate correlated photons. As a result, the two photons show a clear Hong-Ou-Mandel (HOM) interference [5] whose visibility exceeded 90% without the subtraction of any accidental coincidences as shown in Fig. 1. We expect that the OSSB modulator will provide a simple and flexible method for realizing advanced photonic quantum communication systems.

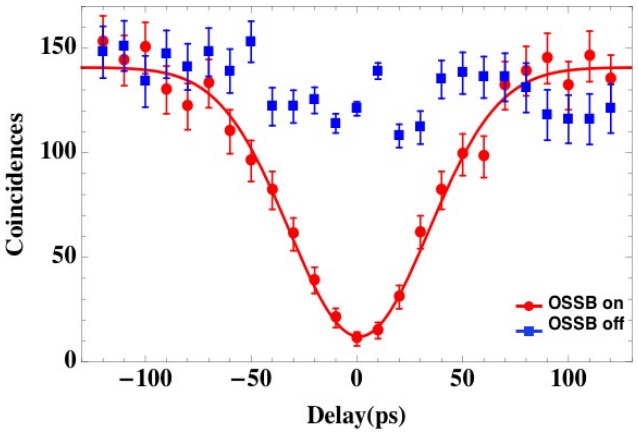

Figure 1: The Hong-Ou-Mandel interference measurement. The non-degenerated photon pair did not exhibit the quantum interference when the OSSB modulator was not operated (squares), but a clear HOM dip appeared with the OSSB modulator on (circles), indicating that the OSSB modulator could erase the frequency distinguishability of single photons.

References:

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